VSEP Vibes Newsletter

Welcome to the New Logic Research Newsletter

Dealing with Ammonium Nitrate Effluent

Ammonia or any kind of Nitrogen is common for most effluents. RO membranes are effective at removing Nitrogen from wastewater. New Logic has installed about 50 projects to treat landfill leachate and anaerobic digester effluent. Both kinds of effluents can have Ammonia concentrations of 2000 to 5000 mg/L. The typical result after the VSEP filtration system with spiral polishing is to have ammonia below 10 mg/L.

Ammonium Nitrate (AN) is a chemical compound with the formula NH_4NO_3. It is produced by mixing Nitric Acid and Ammonia gas. It is commonly used as a high Nitrogen fertilizer and in explosives. It is a white crystalline solid that is very soluble in water. If handled properly like in fertilizers, it is safe to handle, but it can be hazardous if allowed to degrade or be exposed to heat or flames. In the manufacturing of fertilizers and munitions, this can end up in wastewater and elevated levels of Nitrogen are detrimental to the environment. Specifically for Ammonium Nitrate removal, New Logic has pilot tested this many times and has historical data and analytic results from testing.

VSEP is a patented unique membrane filtration system that vibrates and oscillates the membrane. Conventional membrane systems rely on tangential crossflow to create shear at the membrane surface to limit fouling and scaling. But these membrane systems have many limits on the feedwater. These systems cannot take water that would exceed the solubility limits, has suspended solids, oil, or other organics. Because of the vibration of the membranes in VSEP, it does not have these same limits and can accept any kind of wastewater with no pretreatment. VSEP is used when spiral membranes cannot be used but the separation quality of membranes is desired, as in the case of Nitrogen removal.

Sample	NH_4NO_3	Aluminum	Magnesium
Feed Effluent	345,000 ppm	142 ppm	133.5 ppm
NF Permeate	351,000 ppm	**3 ppm**	**16 ppm**
Concentrate	488,000 ppm	734 ppm	565.5 ppm

Often, valuable amounts of NH_4NO_3 can end up in effluents. We pilot tested for one project where they wanted to filter out Aluminum and Magnesium as well as other larger molecular weight materials so that the NH_4NO_3 could be purified and recycled in the process. Nanofiltration was used and was able to significantly reduce the levels of Al and Mg.

Sample	Ammonium	Nitrate
Ammonium Nitrate Feed	4,285 mg/L	2,765 mg/L
VSEP RO Permeate	**991 mg/L**	**265 mg/L**
VSEP Concentrate	10,585 mg/L	25,340 mg/L
Second Spiral RO Pass	167 mg/L	43 mg/L
Third Spiral RO Pass	34 mg/L	8 mg/L

For another Turkish fertilizer company, they had a fairly clean effluent stream containing dilute NH_4NO_3 and they wanted to recover the AN and produce clean water for reuse. We filtered this with three passes of RO membrane. We were able to reduce Nitrate levels from 2765 mg/L to 8 mg/L and made a nice concentrate where the AN could be recovered.

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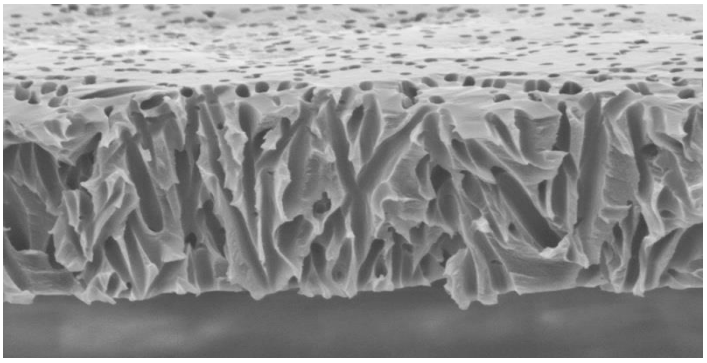
Is PVDF going away?

Polymer chemistry is very complex, and many polymers have been developed and patented starting in 1938. Polymers are Carbon based and are synthesized from petroleum or crude oil. Fluoropolymers are unique and have multiple Caron-Fluorine bonds. This combination makes them resistant to solvents, acids, and bases. The most famous Fluoropolymer is Teflon (Polytetrafluoroethylene or PTFE) which was discovered by accident in 1938 by a Dupont chemist. The Viton elastomer is also a fluoropolymer. Because these polymers are resistant to chemical attack, they do not decompose and last forever. PFAS (Polyfluoroalkyl Substances) is another name used for these chemicals. There are 7 million different chemicals in this category according to PubChem. PFAS chemicals have been discovered to cause health problems and are now found everywhere in the environment, even in rainwater. Government regulators around the world are mobilizing to try to decide what regulations on discharge need to be implemented to protect the public. Many Teflon products such as Teflon frying pans have been banned so far. But the task is daunting and trying to decide which of the 7 million chemicals should be banned will not be easy.



Many chemicals and products are on the chopping block. Polyvinylidene Fluoride or PVDF is now being targeted by EU regulators. This polymer also goes by the brand name Kynar. The EU has put PVDF on the

list of targeted PFAS materials. They are evaluating potential regulations now and will be making a final decision soon. Part of the evaluation will consider the importance of the chemical products that are made verses the risk to the environment.

PVDF is used to make conventional membrane systems and is also used to make hollow fiber membranes such as the ones made by Zenon and Memcor in their Membrane Bioreactor (MBR) package. It is possible these could be banned in the EU. Currently, there are no restrictions or pending bans on PVDF in other places in the world. PVDF membranes are highly hydrophilic which enhances the water transport rates. If PVDF is banned, the membrane market will survive, but the MBR market dominated by Zenon and Memcor would be severely curtailed. The regulators seem to be taking a guilty until proven innocent approach and are asking PVDF producers to prove that this chemical does no harm.

Over coming years, there may be more of this. But evaluating 7 million chemicals used for products seems impossible. While Teflon frying pans have been banned in many areas, Teflon tape is still used in household plumbing. Teflon is also used to make membranes, but there is no mention of banning that. Viton is a common fluorinated elastomer and so far, is on the loose.

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Battle of the Bilge

Oily bilge water is a complex mixture generated in the machinery spaces of cruise ships. It consists of water, oil, lubricants, and cleaning fluids from various sources in the vessel's machinery spaces. It can be managed by retaining it in a holding tank for shore disposal or treating it onboard with an Oily Water Separator (OWS). Cruise ships can produce between 1,300 to 5,300 gallons of bilge water daily, depending on size and operational factors. Discharges of oily mixtures are prohibited within 12 nautical miles of land unless specific conditions are met, including oil content not exceeding 15 parts per million (ppm). Oily Water Separators (OWS) are used to extract oil from bilge water, with a requirement to maintain oil content below 15 ppm for discharge. The complexity of bilge water composition can hinder effective treatment, especially when cleaning agents create emulsions that are difficult to separate. Discharge violations can lead to significant penalties, including detention of vessels and legal actions. One pint of spilled oil can create a sheen over an acre of water, killing surface-dwelling marine organisms. The toxicity of oil varies; polycyclic aromatic hydrocarbons (PAHs) are particularly harmful and can have long-lasting effects on marine biota. Different oil types have varying environmental impacts, with lighter oils being more toxic but evaporating quickly, while heavier oils can cause prolonged contamination. Over 75 cases of intentional discharges of oily bilge waste have been prosecuted, resulting in over $150 million in fines since 2000.

Because of the difficulty treating oil onboard, many ships will transfer their wastewater to a treatment facility in port. These are generally private companies who are paid to receive the waste. Bilge water would not be suitable to sewer to the local POTW and will require special treatments to make it clean enough to discharge. New Logic has installed two bilge water treatment plants at these port receiving facilities. One was in the Caribbean, and one was in Belgium. In addition, New Logic has pilot tested its VSEP vibratory membrane at several other facilities. Because spiral wound RO membranes have very tight spaces between the membrane, they have limited ability to handle oily water directly. The membranes are hydrophilic and if crossflow cannot wash the oil from the membrane, it will have a hydrophobic surface and will repel water. But, because VSEP uses vibratory oscillation at high speed, the oil micelles cannot attach to the membrane and it stays hydrophilic, The VSEP will also not require any chemicals or pretreatment and can use direct RO for water with high oil content. During a recent bilge water pilot test in the Caribbean, VSEP RO was able to produce permeate with only 0.4 mg/L oil and grease and only 39 mg/L total dissolved solids. The system ran with an average flux rate of 36 GFD (61 LMH) and a permeate recovery rate of 90%.

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Security Threats for Water Systems

In today's world with hackers, ransomware, and even malicious state actors, the security of our water, telecom, and power infrastructure is critical. American Water Works is the largest water and wastewater utility in the country. Recently, they announced that there was unauthorized activity on the computer networks and systems and classified it as a cybersecurity breach. The company announced that so far there have been no negative impacts and that they are still investigating the extent of the breach.

After a new VSEP system is installed and commissioned at the customer's facility, it is often useful to have New Logic Research engineers and/or programmers update the control system with minor adjustments based on customer feedback or unexpected interactions between VSEP equipment and surrounding systems. Some of these changes can be made easily by adjusting existing system settings at the HMI to achieve the desired behavior, but in some cases a change in the PLC or HMI programs is needed. Many years ago, this would require costly travel or a hired local 3rd party so that a programmer could connect directly to the device and upload the changes needed. In today's world, the more cost-effective solution is to connect to the PLC and/or HMI remotely in real time to quickly make the changes needed, saving all parties significant time and money.

New Logic Research provides built-in secure remote access options on all full scale VSEP systems and some pilot rental systems. This is achieved with industry leading devices that use robust security measures to ensure there is no direct exposure of PLC/HMI and other devices to the internet. In most cases Weintek EasyAccess 2.0

is used directly integrated into the HMI providing a secondary ethernet port to the outside world. This port and the EasyAccess software use SSL/TLS encryption (AES 256-bit and RSA 2048-bit) for all data transmission as well as Multi-Factor Authentication (MFA via email OTP). These features ensure secure remote access to HMI/PLC and other subnetwork devices by creating a fully encrypted VPN connection eliminating the need for complicated firewall or router setups while protecting against any direct exposure of devices on that subnetwork to the internet. In other cases, in which Weintek HMI is not used, the same type of connection is achieved using the Ewon COSY device which has the same robust features and functionality.

New Logic Research manages these systems including user access credentials while giving the customer full control over the connection itself so that the client can decide when the connection is available at all. Customers with more sophisticated IT systems can of course provide their own remote access systems if they prefer.

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New Biogas Regulations

Legislation has advanced in the Iowa House that would regulate anaerobic digesters in the State. The new regulations would require farming operations to get a permit and to follow the rules from the Department of Natural Resources before building, upgrading, or expanding an anaerobic digester. Currently, there are only about 10 of these in Iowa and they are mostly at Daries.

The new regulations would also cover storage structures and how the digestate is applied to farmland. This may require limits on lbs/acre or other rules about land application. Another key factor is the placement of the digesters and their location in relation to houses and other facilities. House members are also working on additional legislation for non-dairy digesters where food waste and other organic materials are used for Biogas production. An amendment was filed to the new legislation to also require monitoring of PFAS chemicals in the digestate effluent, but it was decided that this should be done separately. There is already legislation regarding PFAS that can be found in Municipal sewage treatment plant sludge that is used as a fertilizer. This bill will advance to the State Senate.

New Logic has installed 25 biogas effluent treatment systems to make very clean water that can be reused or easily discharged. The concentrate from the VSEP system can be hauled as a concentrated liquid slurry for land application or can be dried and sold as a fertilizer product. Biogas production can produce income and can involve government subsidies, but the cost of digestate handling and disposal can be a big expense. There are many energy companies and other private companies that build biogas plants and negotiate contracts to take manure, food waste, or other organic materials. But the cost of digestate management can determine whether the plant is profitable or not.

Many people have tried conventional spiral membranes for this application with a lot of pre-treatments. These can be problematic and may not reduce the volume of digestate much. VSEP can run reliably at higher recoveries. Ammonia and Total Dissolved Solids can be very high and need to be reduced to low levels. With two stages of RO including a VSEP RO and a spiral RO, we can reduce ammonia from 2000 mg/L to 30 mg/L. With a 3rd stage, Ammonia can be less than 5 mg/L. The concentrate can be dried and sold as a fertilizer.

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EPA: "VSEP is the Best Available Technology"

People don't often think about how much water is used to make electricity. When Natural gas or Coal is burned to make electricity, the heat is used to make steam which turns large generators. Fresh water is used to make steam. Then a cooling loop is used to cool the generators, and this involves cooling towers that evaporate water to purge the heat energy. Additionally, when the coal is burned the exhaust gases that travel up a flue are "scrubbed" with a water mist to remove heavy metals and sulfur so the plant can meet air quality requirements. What you see coming out of a flue gas stack at a power plant is mostly steam water. The scrubber water is periodically purged to maintain a constant level of contaminants. This becomes wastewater and is called Flue Gas Desulfurization (FGD) water. In addition to that, the combusted coal becomes an ash called fly ash that is stored onsite. When it rains, water percolates through the fly ash pile and becomes a leachate that is collected and stored in ponds.

These ponds that store FGD effluent and ash leachate are facing strict rules for discharge. The EPA says that this effluent contains many pollutants such as Selenium, Mercury, Arsenic, and Halogens such as Chloride, Bromide, and Iodide. It says that discharge of these things all sorts of health risks to humans and aquatic life. On April 25th, 2024, the EPA announced its final rule for discharge of this kind of water and had set a timeline for compliance. The EPA estimated that the new discharge requirements would reduce these pollutants by 660 million pounds per year. They also claim that this reduction will result in $3.2 Billion in public health benefits. The cost of compliance would be high and I'm not sure how it compares to the cost benefits, but the EPA claims that the extra cost of compliance for coal power plant would only result in a $3.50 electricity price increase per year. At the beginning of this year, the EPA announced that more time would be given for

compliance, but the word on the street is that the rules will not change and will need to be addressed in due time.

New Logic has been working on this application for more than a decade. We have demonstrated the VSEP RO technology at full scale and have been named as the best available technology by the EPA for this application. In 2014, Jay Renew with the Georgia Institute of Technology published a paper describing the results of full-scale VSEP testing at the Water Research Center at the Plant Bowen facility owned by Southern Company. This work was done in conjunction with EPRI, an industry organization who evaluates technology options.

The author concluded: "Contaminant removal efficiencies, flux rate, and percent water recovery of the VSEP/RO system were evaluated during a three-month test program using gypsum-saturated FGD wastewater. The VSEP/RO system effectively removed selenium, mercury, arsenic, and nitrate/nitrite from gypsum-saturated FGD wastewater. From total dissolved solids (TDS) levels of up to 16,000 mg/L (or ppm), to levels below the proposed effluent guidelines. The first stage, VSEP pilot unit, removed approximately 94% TDS, while the second stage, Spiral RO pilot unit, removed an additional 5.8% TDS, yielding an overall TDS removal efficiency of 99.8%. "

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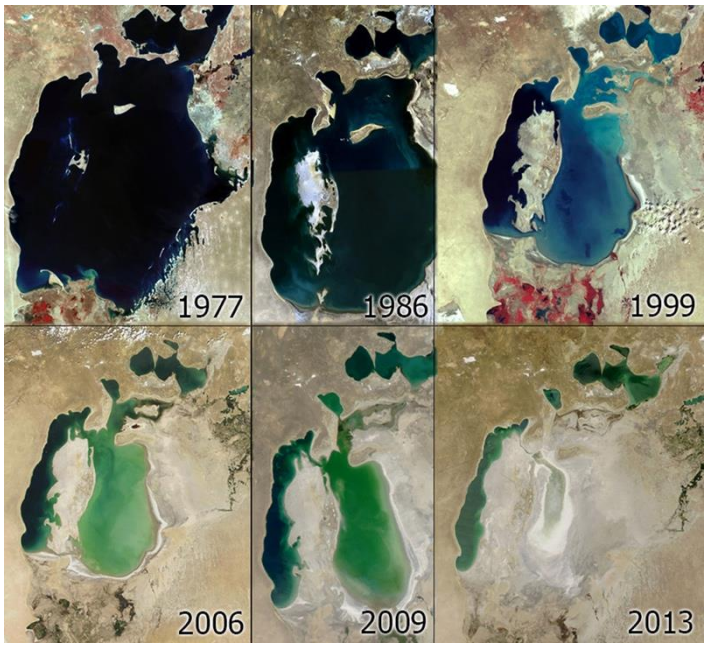
Water Wars

Disputes over fresh water are underreported and happen all around the world. Rivers often form borders of countries that share this resource. Disputes can happen over fairness, especially in areas where water is scarce. Large populations can be found in arid areas. Los Angeles is a good example where there are plenty of green lawns and swimming pools, but the area was really a desert before human habitation.

I have discussed previously how there is a water sharing agreement between the US and Mexico regarding the Colorado River which flows through Lake Mead and finally crosses the border into Mexico. Flows through this river have been reduced and water diverted to Arizona and Southern California have been cut. Another water sharing agreement exists for the Rio Grande which starts in the Rocky Mountains and runs along the border between Mexico and the US. The reiver is also fed by tributaries from Mexico which has diverted water from these to storage reservoirs. This has caused recent disputes. I have also discussed the Indus River dispute between India and Pakistan. These flows have been restricted by India and the fertile valley that relies on this water in Pakistan has suffered. Ethiopia is currently diverting Blue Nile water to fill a reservoir that could reduce the flow of the Nile in Egypt by 25%. There is even talked of armed conflict over this.

The Amu Darya River forms the northern border of Afghanistan and is the main source of water in Central Asia/ Afghanistan is building large canal water infrastructure project called the Qosh Tepa Canal. It is a 285-kilometer aqueduct that will divert 25% of the Amu Darya River's flow to irrigate 500,000 hectares of farmland. The river starts in the high mountains of Tajikistan and flows by the northern border of Afghanistan and then through Turkmenistan and Uzbekistan finally emptying into the Aral Sea



Water flow into the Aral Sea has been diverted for years to fertilize farmlands in the region. Because of this massive water diversion, the Aral Sea has been shrinking for many years and is now only a small fraction of the size it once was. Further water diversion from the Qosh Tepa Canal will accelerate this process. Uzbekistan and Turkmenistan rely heavily on the Amu Darya River for agriculture and hydroelectric power. By the time the flow gets to Turkmenistan, the flow could be reduced by as much as 80% leading to reduced crop production, job losses, poverty, and certainly cross-border tensions.

Water is our most precious resource and managing its distribution and consumption will be vital in the years to come. Instead of using water once and then throwing it away, more focus needs to be on reuse of water that is recycled. New Logic is very active in this area and with its VSEP technology is collaborating with companies to reduce their water footprint.

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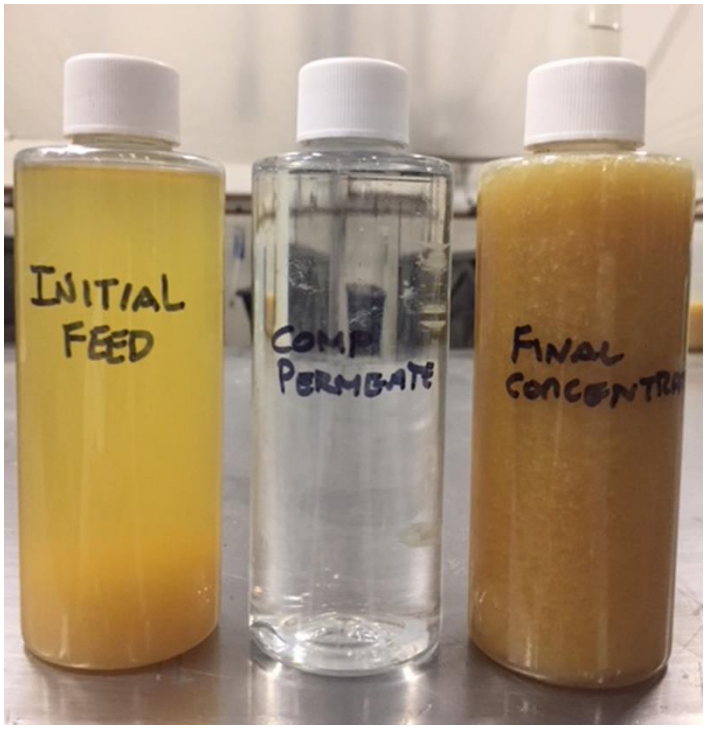
Nejayote Filtration with VSEP

When corn is cooked, steeped, and ground to make tortillas or corn chips, it is called Masa. The wastewater from this process is called Nejayote and it can contain some interesting polyphenol antioxidants. It is an alkaline liquid because of the Nixtamalization (lime water) of the corn to break down the hull and starch. The corn is cooked in large vats of water to soften the kernels. This process helps to break down the starches in the corn and makes it easier to grind into a fine masa. The cooking process typically involves steeping the corn in water for several hours, followed by a series of rinses and drains to remove any excess moisture. The cooked corn is then left to steep in its own moisture.

Nixtamalization is soaking the corn in a lime water alkaline solution to remove the hulls and germ. This process helps to increase the nutritional value of the corn as well as its flavor and texture. After the corn has been cooked and nixtamalized, it is ground into a fine masa using a large grinder. The masa is then mixed with water and other ingredients to create a dough-like consistency. In recent years, there has been a growing concern about the environmental impact of corn chip production. Corn chip manufacturers are now looking for ways to reduce their environmental footprint, such as using sustainable ingredients, reducing water usage, and implementing recycling programs.

New Logic ran pilot tests for a tortilla chip manufacturer that was discharging their wastewater to the sewer. They paid a surcharge for suspended solids and biological oxygen demand (BOD). They did have a vibrating screen that removed some of the suspended solids, but the surcharge fees were high. They were interested in using VSEP to filter the water using a RO membrane. This was, they could either discharge the water for free or reuse it. The concentrate could have value if dried.



We completed pilot testing using an LP VSEP set up in their shop and took the effluent after the vibrating screen. Since the pH of the Nejayote was 11.5, sulfuric acid was used to lower the pH to safe levels for use with RO. The effluent temperature during testing was 95°F (35°C). The result was that we were able to make very clean water at an average flux rate is 19 gfd (32 lmh) with a recovery rate of 90% leaving only 10% as a concentrate.

Because the water contained lime, starch, and larger organic materials, the RO membrane was able to remove almost everything making near distilled quality water. The BOD was reduced from 11,000 mg/L to 63 mg/L. The suspended solids were reduced from 2380 mg/L to zero. Conductivity, an indicator for dissolved solids, was reduced from 2,550 mg/L to 65 mg/L. The customer is exploring the option while reusing wastewater can have some psychological impediments, sewering costs would be removed.

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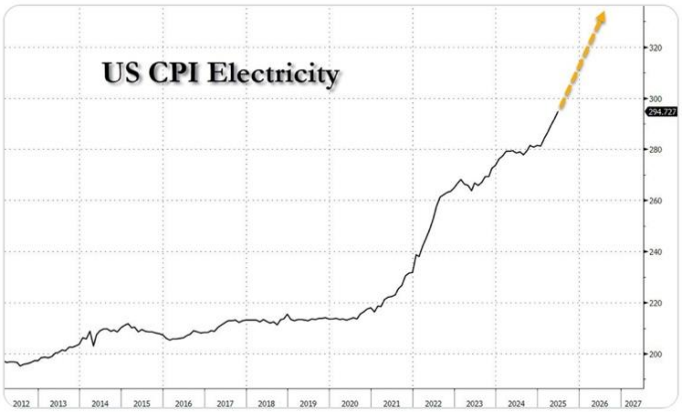
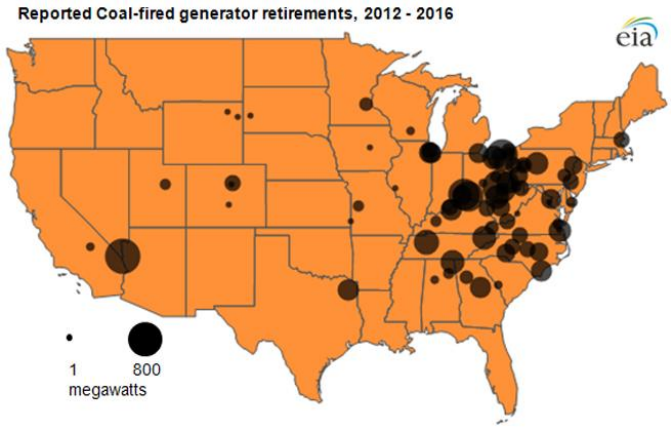
Econ 101 - Supply and Demand

There is a movement to completely restructure the nation's energy grid especially as it relates to coal. New Jersey has decided to close nuclear, and coal fired power plants in the state without providing a replacement energy source. In June, the New Jersey Board of Public Utilities approved a 17-20% electricity price increase for consumers. A Goldman analyst reports that 9 of the 13 power grids across the country have reached dangerously low levels of spare capacity and that this will lead to potential blackouts and price spikes during times of high demand. The most urgent are the Mid-Atlantic states serving 65 million people including Maryland and New Jersey. In July, the US Department of Energy issued its fifth emergency order allowing operation of generation units in excess of their operating limit.

In 2010, there were about 500 coal fired power plants operating. Over the next nine years 290 of them have been retired and taken offline. This is nearly 60% of the coal-fired capacity. Since 2011 about 140 GW of electrical energy from coal has been taken offline. When a coal power plant is taken offline, sometimes it is replaced with natural gas at great expense and often with the costs passed on to rate payers. Building a new power plant can cost $3B USD. Decommissioning a plant also costs a huge amount.





Fossil Fuel power plants and especially coal power plants have been the target of the Sierra Club and other environmental organizations. They have been quietly suing power plants through the EPA with the apparent purpose of stopping fossil fuel use. This has led to very costly litigation, plant closures, and expensive court ordered injunctions. In 2024, 24 GW of coal power was taken offline worldwide, mostly in countries like the US that are buffeted by litigation. However, in the same year 44 GW of new coal energy production came online, mostly in countries like China where regulations and litigation are not present.

All of this is happening at a time when AI data centers are rapidly expanding across the country. As of March 2025, there were 5,426 data centers in the US with many being placed in the Mid-Atlantic states like in Virginia where power capacity is stretched. In 2023, data centers used 4.4% of the total US electricity. This is projected to increase to as much as 12% by 2028. Large data centers can use 100 MW of power which is

enough to power 80,000 households. The rapid drastic change in the grid combined with increasing capacity demands is reaching critical levels. A more rational pace of energy replacement needs to happen since our energy security is at risk. New Logic has been doing our part to provide VSEP effluent treatment systems for coal-fired power plants. In this way, clean water can be obtained, and these coal plants can continue to operate in a safe and reliable way. We have worked with several coal power plants that were slated for retirement, but that has been postponed due to critical levels of spare capacity, especially in the Mid-Atlantic states.

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